DCM-501
Chemical Engineering Thermodynamics

UNIT- I

Systems & Processes, States & properties, State & Path functions, Reversible & Irreversible Process, Thermodynamic equilibrium, Zeroth Law Statement, Internal Energy, Enthalpy, Heat Capacity, Ideal Gas Temperature scale. First Law of Thermodynamics for: Cyclic Process, Adiabatic, Isothermal, Isobaric Processes; Simple problems on 1st law of thermodynamics.

UNIT- II

Second Law of Thermodynamics: Statement, Carnot Cycle, Carnot Principle, Clausius inequality, Concept of Entropy, Simple problems.

UNIT- III

Free Energy, Work Function, Chemical Potential, Fugacity, Gibbs-Duhem Equation, Gibbs Helmholtz Equation, Clapeyron Equation.

UNIT- IV

Preliminary concept of Ideal & Real Gases---Vander Waal's Equation, Redlich-Kwong, equation--- Peng, Robinson equation, Benedict-Webb-Rubin equation(all statements only)-Equation of Corresponding state, Compressibility factor, Standard Heat of Reaction, Combustion, Formation-Hess's Law.

UNIT- V

Statement of Third Law of Thermodynamics-Ideal Refrigeration Cycle, Air Refrigeration Cycle, Vapor Compression Cycle, Absorption Refrigeration Cycle & Vacuum refrigeration-Choice of Refrigerant-COP- Ton of Refrigeration, Refrigeration Capacity, Simple problems.

References:

1. Introduction to Chemical engg thermodynamics Smith &,Vanness McGrow-Hill Book Co.
2. A Textbook of Chemical Engineering Thermodynanics K.V.Narayanan PHI.
3. Chemical engg Thermodynamics Dodge McGrow-Hill Book Co.

List of experiments:

1. To determine the Critical Solution Temperature of a Binary system (Phenol- Water system).
2. To study three components Ternary Phase diagram for the following system:-. a) System: Water- Acetic acid- Chloroform. b) System: Water- Toluene- Acetic acid.
3. To study the variation in the solubility of Calcium- Hydroxide in the presence of Sodium Hydroxide and hence determine the solubility product of Calcium Hydroxide with variation in Temperature.
4. Determination of the solubility of Benzoic Acid over a range of temperature and hence Heat of solution.

5. To determine the energy of activation of hydrolysis of methyl acetate catalyzed by hydrochloric acid.

DCM-502
Heat Transfer

UNIT-I

Conduction: Modes of heat transfer, Concept of steady & unsteady state heat transfer process, One-dimensional Fourier's equation — Steady state heat transfer through Flat Plate, cylinders and spheres .

UNIT-II

Convection: Basic concept of natural & forced convection, Heat Transfer Coefficients, Importance of dimensionless numbers involved in convective heat transfer process: Reynolds's number, Prandtl number, Nusselt number, Grashoff number, Forced convection inside tube, Critical Radius Of Insulation.

UNIT-III

Radiation: Definition, Black Body, Grey Body, Emissivity, Reflectivity, Absorptivity, Transmissivity, Kirchhoff's law, Stefan-Boltzmann law, Black body radiation.

UNIT-IV

Heat Exchangers: Concept of log-mean temperature difference, Individual & overall heat transfer co-efficient, Double pipe heat exchanger,Shell & tube heat exchanger & their industrial application, Simple problems.

UNIT-V

Evaporators: Types of evaporators, Elementary principles of single & multiple effect evaporators, Basic calculation of single effect evaporator.

References: -

1. McCabe Smith; Unit Operation for Chemical Engg. TMH
2. Heat Transfer- Principles And Applications—Dutta--PHI
3. Process Heat Transfer: DQ Kern—McGraw Hill

List of experiments

1. To determine the linear expansion co-efficient of a metal rod
2. To determine overall heat transfer co-efficient for a double pipe heat exchanger
3. To determine the overall heat transfer co-efficient for a shell and tube heat   exchanger
4. To determine rate of evaporation in a jacketed open pan evaporator.
5. To determine the thermal conductivity of solid metal steel rod.
6. To determine the thermal conductivity of bricks in series.
7. To determine the rate of heat transfer through bricks in series.

DCM-503 Mass Transfer

UNIT-I
General principles of mass transfer & its applications, Mass transfer coefficients, Concept of diffusion, diffusivity, application of molecular diffusion, Simple numerical problems.

UNIT-II
Mass transfer coefficients, Concept of channeling, loading & flooding, Types & selections of regular & random packing.

UNIT-III
Absorption: Concept of absorption & stripping, Choice of solvent for absorption, minimum solvent requirement, Absorption factor, Concept of HETP, HTU & NTU, Simple calculation of diameter and height of packed column using NTU & HTU method.

UNIT-IV
Distillation: Concept of relative volatility, Concept of batch, continuous, flash, vacuum, steam, low pressure, molecular, azeotropic, extractive & multicomponent distillation, Minimum & optimum reflux, Simple calculation of number of theoretical plate based on Mc cabe–Thiele method. Basic concept about bubble cap tray & sieve tray column

UNIT-V
Extraction: Concept of liquid extraction, Use of triangular diagram, Selectivity, choice of solvent, Basic concept about percolation tank, Dorr – agitator, thickener & classifier, hydro cyclone, rotocell, Kennedy & Bollman extractor

References:

1. Mass Transfer Operations-Trebal-McGraw Hill
2. Unit Operations of Chemical Engineering- McCabe and Smith
3. Principles of Mass Transfer And Operation- Binay k Dutta.
4. Chemical Engineering, Vol. 1, 2, 4 & 5, Coulson and Richardson Pergamon Press, Oxford.

List of experiments

1. To determine molecular diffusivity of a substance through a non-diffusing gas.
2. To verify rayleigh's equation for batch distillation of a binary mixture.
3. To study solvent extractions.
4. To study wetted wall columns.
5. To study mass transfer in a spray tower.
6. To study azeotropic distillation.
7. To study equlibrium distillation by othmer still.

DCM-504 Mechanical Operations

UNIT- I

Size Reduction: Crushing & grinding, Laws of crushing, Close circuit & open circuit, working principle of jaw crusher, Roll crusher, Hammer mill, Ball mill.

UNIT- II

Mechanical Separation: Sampling, Screening, Elutriation, Froth Flotation, Jigging, Heavy media separation, Cyclone, Bag Filter, Electrostatic Principle, Electromagnetic Separator.

UNIT- III

Material balance: Introduction of component balance solving material balance, with and without simultaneous equation at steady state material balance, recycle bypass and purge calculations.

UNIT- IV

Filtration and Washing: Constant Rate & Constant Pressure Filtration, Batch & Continuous Filtration equipment, Plate & Frame filter, Rotary Drum Filter, Leaf filter, Filter Aids.

UNIT- V

Mixing and Agitation: Types of impellers used in stirred tank, Study of power consumption of mixers, Dimensional analysis of power consumption, Construction and working of stirred tank mixer & sigma mixer.

References:

1. Unit operations of Chemical Engineering McCabe and Smith McGraw Hill.
2. Mechanical Operations for the Chemical Engineers—Narayan, Bhattacharya.
3. Mechanical Operations-Swain-McGraw Hill

List of experiments:
1. Sphericity factor on friction losses.
2. Drag studies
3. Filtration (constant rate)
4. Filtration (constant pressure)
5. Screening
6. Cyclone separator
7. Jaw crusher
8. Ballmill
9. Particle size distribution

DCM-504 (A) Oil & Paint Technology

UNIT- I

Chemistry of Oils, Fats and Fatty Acids: i. Glycerides, ii. Fatty Acids, iii. Non Glyceride Components of Oils & Fats iv. Chemical Reactions of Fats and Fatty Acids.

UNIT- II

Technology and Production of Oils & Fats, Coconut, cotton seed, peanut, palm, sunflower, sesame, softlower, rice fran, rapeseed and mustard seed, linseed, soyabean, tung, casteroil lard and tallow. Minor Oils: Neem Oil and Salfat.

UNIT- III

Degumming, alkali refining (batch refining), Miscella refining, refining loses – Bleaching by absorption – continuous bleaching.

UNIT- -IV

Hydrogenation : Mechanism – selectivity as applied to the reaction and catalysis, Hydrogenation in practice (Batch & continuous) preparation of Raney Nickel catalyst, Soap manufacture : Raw materials required, selection of raw materials – full boiled process.

UNIT- V

Nutritional functions of fats, Testing and important analysis of oils and fats in determining the quality and quantity of oils / fats and oilseed; such as moisture, oil content, F.F.A., protein content, color of the raw / refined oil.

References:
1. Feireidoon Shahidi, Bailey's Industrial Oil and Fat Products
2. E. Bernardini, Oils & fats Technology
3. W.M.Morgan, Outlines of Paint Technology
4. V.C.Malshe & Meenal Sikchi, Basics of Paint Technology, Part I & II,.

DCM-505 (B) POLYMER TECHNOLOGY

UNIT- I

Polymerization Chemistry: Chain, step and miscellaneous polymerization reactions and polymerization technique. Polymerization kinetics: Free radical, cationic and anionic polymerization.

UNIT- II
Polymerization Processes: Bulk solution, emulsion and suspension polymerization, thermoplastic composites.

UNIT- III
Polymer reactions: Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of various specific groups.

UNIT- IV
Manufacturing processes of important polymers: Plastics- polyethylene, polypropylene polyvinyl, Phenol-formaldehyde, elastomers, robbers, polymeric oils - silicon fibers - cellulosic (Rayon), polyamides (6:6 Nylon), Polyesters (Dacron).

UNIT- V
Composite materials: Ceramic and other fiber reinforced plastics, Polymer degradation - Thermal, Mechanical, Ultrasonic, Photo, High energy radiation.

References:
1. Rodringuez; Principles of polymer systems; TMH
2. Billmayer Jr, Fred W.; Textbook of polymer science; Wiley tappon
3. David J Williams; Polymer science & engineering; PHI
4. Mc. Keley, JH; Polymer processing; John Wiley.